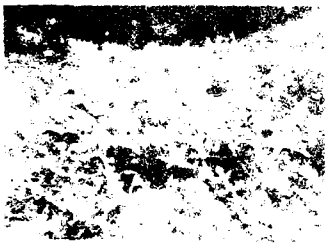

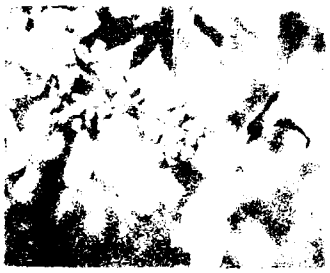

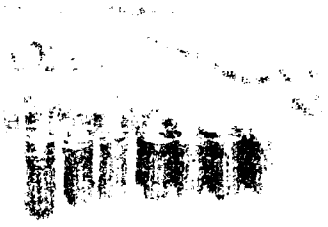

DEPARTMENT OF DEFENSE
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FLOWERING DOGWOOD (*Cornus florida*)

Section 7.5.9, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

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PO Box 631, Vicksburg, Mississippi 39180-0631

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Final Report

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A plant materials report on flowering dogwood (*Cornus florida*) is provided as Section 7.5.9 of the US Army Corps of Engineers Wildlife Resources Management Manual. The report was prepared as a guide to assist the project biologist with the selection, cultivation, and management of suitable plant materials for wildlife and habitat development programs. Major topics covered are description, distribution, habitat requirements, wildlife value, establishment, maintenance, and cautions and limitations.

Flowering dogwood is a native deciduous understory tree common to upland hardwood and mixed pine-hardwood forests of the eastern and southeastern United States. It provides food for a variety of wildlife species, particularly woodland songbirds, wild turkey, and white-tailed deer. The distribution and distinguishing characteristics of flowering dogwood are described, and common varieties are noted. Habitat requirements are

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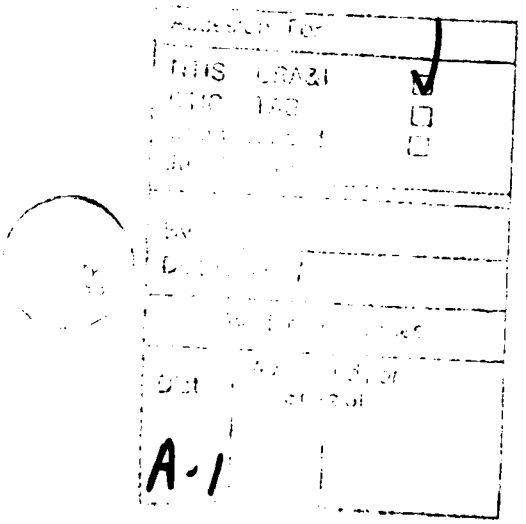
specified, and common plant associates are listed. Benefits to wildlife, including the nutritional value of fruits and foliage, are discussed. Guidelines are provided for establishing dogwood in suitable habitats; specifications are given for site selection, site preparation, propagule selection, and methods of propagation. Maintenance requirements and appropriate cautions are discussed.



PREFACE

This work was sponsored by the Department of Defense (DOD) military branches under the DOD Natural Resources Program. Technical Monitors for the study were representatives of the Fish and Wildlife Committee of the Defense Natural Resources Group, DOD. The report serves as a section of the US Army Corps of Engineers Wildlife Resources Management Manual, as developed by the Office, Chief of Engineers, US Army, under the Environmental Impact Research Program.

This report was prepared by Dr. Wilma A. Mitchell, Ms. Patsy A. Gibbs, and Mr. Chester O. Martin, Wetlands and Terrestrial Habitat Group (WTHG), Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES). Ms. Gibbs was employed by WES under an Intergovernmental Personnel Act agreement. Mr. Martin, Team Leader, Wildlife Resources Team, WTHG, was principal investigator for the work unit. Review and comments were provided by Drs. Mary C. Landin and Charles V. Klimas, WTHG, and Mr. Harry R. (Randy) Smith, Mississippi Cooperative Extension Service.

The report was prepared under the general supervision of Dr. Hanley K. Smith, Chief, WTHG, EL; Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL; and Dr. John Harrison, Chief, EL. The report was edited by Ms. Jessica S. Ruff of the WES Information Products Division (IPD). Drawings were prepared by Mr. David R. (Randy) Kleinman, Scientific Illustrations Section, IPD, under the supervision of Mr. Aubrey W. Stephens, Jr.

COL Dwayne G. Lee, CE, was the Commander and Director of WES. Dr. Robert W. Whalin was Technical Director.

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NOTE TO READER

This report is designated as Section 7.5.9 in Chapter 7 -- PLANT MATERIALS, Part 7.5 -- WOODY SPECIES, of the US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 7.

FLOWERING DOGWOOD (*Cornus florida*)

Section 7.5.9, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

Flowering dogwood (*Cornus florida*) is a shade-tolerant, deciduous understory tree common in young forests and mixed pine-hardwood stands in the eastern and southeastern United States (Johnson 1961, Halls 1977, Harlow et al. 1979). It is a member of the dogwood family (Cornaceae), which is represented by approximately 100 species found mostly in temperate regions (Brockman 1986). Other common names for flowering dogwood are American dogwood and white dogwood; it is also occasionally called arrowwood, boxwood, or cornel (Johnson 1961).

Dogwoods are of high value to wildlife, and the fruits are preferred food items for many game and nongame species (Arner and Davison 1976, Halls 1977, DeGraaf and Witman 1979, Warren and Hurst 1981). Most upland game birds within the range of flowering dogwood consume the fruits, and it is an important food plant for white-tailed deer (*Odocoileus virginianus*) (Halls 1977).

Flowering dogwood is considered one of the best native ornamental trees in the East, and numerous cultivars have been developed for landscaping purposes (Gill and Healy 1974, Dirr 1977). The hard, heavy, shock-resistant wood is also used to make shuttleblocks, spools, mallet heads, and other

specialty products (Johnson 1961, Halls and Alcaniz 1972, Halls 1977). In this report the species will usually be referred to only as dogwood.

DESCRIPTION

Flowering dogwood is a small horizontally branching tree that usually grows 20 to 25 ft (6 to 7.6 m) tall (Dirr 1977). Near the northern limits of its range, dogwood is only a multiple-branched shrub (Vimmerstedt 1957), while on good sites further south it will grow to 40 ft (12 m) and attain a diameter at breast height of 12 to 18 in. (30 to 45 cm) in 20 to 30 years (Fowells 1965).

The bark is thin, dark brown to black, and breaks into many rectangular scaly blocks early in its growth (Harrar and Harrar 1962) (Fig. 1). The simple opposite leaves are ovate-elliptic, abruptly acuminate at the tips, and have 6 to 7 pairs of arcuate veins (Dirr 1977). Leaves are dark green above and glaucous beneath during the growing season and turn rose to scarlet and violet in autumn. The green twigs are dichotomously branched and ringed at the nodes.

The small, inconspicuous flowers are greenish white to creamy, perfect, and borne in compact heads surrounded by 4 white (occasionally pink), petal-like, deciduous bracts 1.3 to 2.5 in. (3.3 to 6.4 cm) long (Johnson 1961, Preston 1961, Radford et al. 1968). The flowers open with leaf expansion--in March at the southern end of the range to June in northern areas (USDA Forest Service 1948). Flower buds and bracts are set the previous fall and are conspicuous on the fall/winter twigs. Dogwood fruits are ovoid scarlet drupes, 0.5 in. (2.5 cm) long and 0.25 in. (1.3 cm) in diameter, borne in clusters of 2 to several with the persisting calyx and style evident. The pit is ovate, 2-celled, and somewhat grooved (Harrar and Harrar 1962). Drupes ripen from September through late October (USDA Forest Service 1948).

Because of its popularity as an ornamental, numerous cultivars of flowering dogwood have been developed. Dirr (1977) listed 22 cultivars, including several that have pink to red bracts. Four varieties commonly propagated are 1) *Cornus florida pendula*, which has pendulous branches; 2) *C. f. rubra*, with red or pink bracts; 3) *C. f. pluribracteata*, with 6 to 8 large and several small bracts; and 4) *C. f. xanthocarpa*, which has yellow drupes.

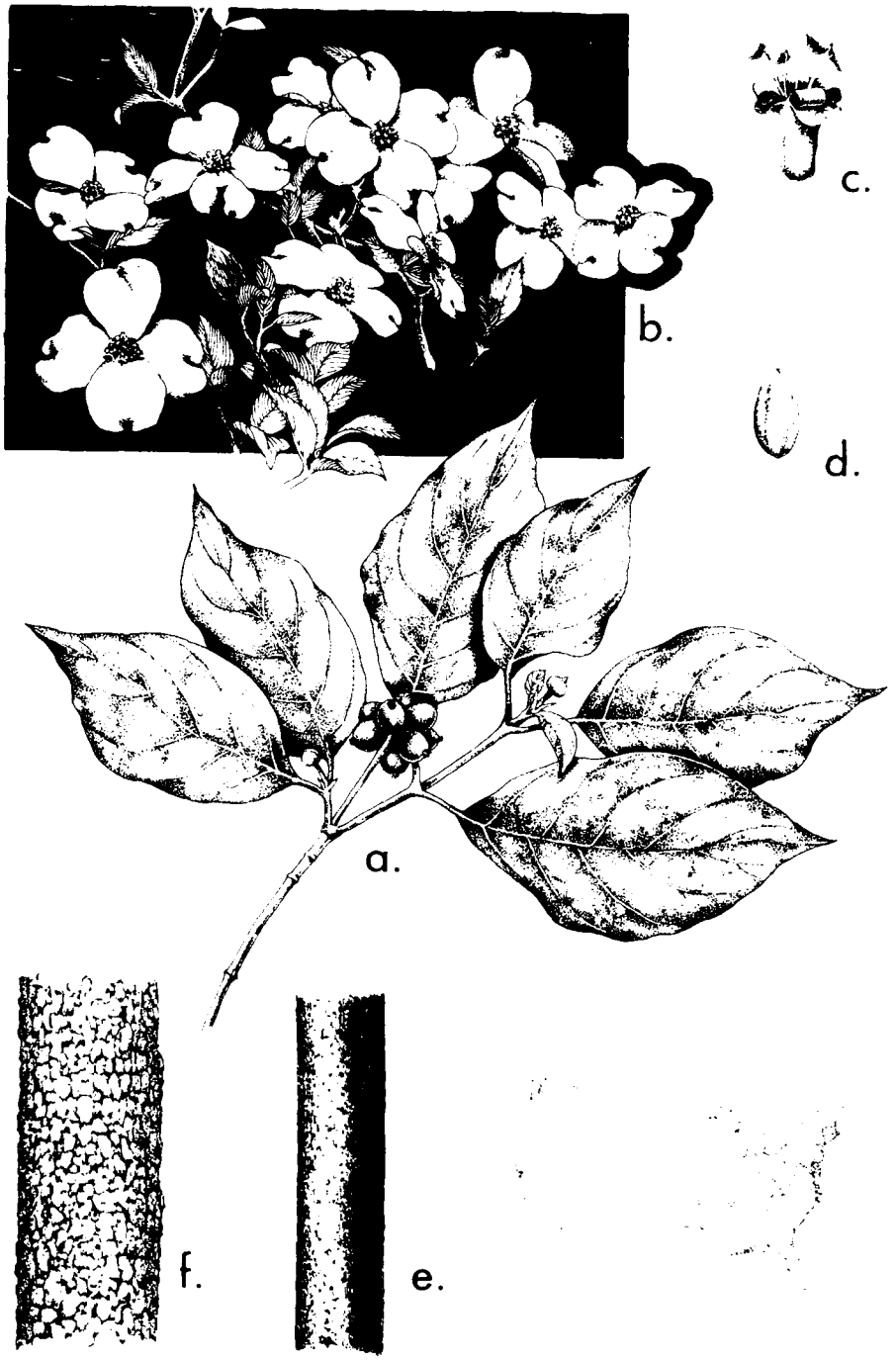

Figure 1. Distribution and distinguishing characteristics of flowering dogwood (*Cornus florida*): (a) fruiting branch with winter bud, (b) flowers with showy white bracts, (c) individual flower, (d) seed, (e) smooth young bark, and (f) blocky bark of older trunk

DISTRIBUTION

Flowering dogwood is native to the eastern United States. It ranges from Massachusetts and New York westward to southern Michigan, southeastern Oklahoma and eastern Texas, and south to central Florida and the gulf coast; disjunct populations occur in the mountains of eastern Mexico (Harrar and Harrar 1962, Fowells 1965, USDA Forest Service 1973, Harlow et al. 1979). The species is widely distributed throughout its range except in the bottomland forests of the Mississippi River Delta (USDA Forest Service 1973), where soils are too wet and heavy for its survival (Fig. 1).

HABITAT REQUIREMENTS

Dogwood tolerates a wide variety of climatic conditions. Average annual temperatures range from 45° to 70° F in the South, but dogwood withstands summer temperatures as high as 115° F in northern Florida and winter temperatures as low as -30° F in New England and the northern states. The growing season varies from 160 days in southern Michigan to 300 or more days in Florida (Fowells 1965).

Shade

Flowering dogwood is well adapted as an understory tree. The species is common along forest borders, on south- and west-facing slopes, and near streams (DeGraaf and Witman 1979). It is found on open hillsides and ridges, usually growing in the shade of other hardwood trees (Harrar and Harrar 1962). The species grows well under a forest canopy and has the ability to carry on maximum photosynthesis at one-third full sunlight (Fowells 1965). However, it flowers most prolifically and produces fruit at an earlier age when grown in the open (Korschgen 1967, Wells and Oefinger 1969, Wells 1973).

Soils

Dogwood grows in a wide variety of soil textures from well-drained uplands to the deep, moist soils of streambanks (Johnson 1961). It is more common on soils with good internal drainage and light texture and is usually scarce or absent on heavy, poorly drained soils (Chong [illegible], Johnson 1961, Pirl [illegible]). The species prefers acid soils and gives the best growth response on rich, moist loams with ph values of 6 to [illegible] (Johnson 1961).

Moisture

The average annual precipitation within the geographic distribution of flowering dogwood ranges from a low of approximately 30 in. in northern states to approximately 60 in. in portions of the Southeast. However, plants are intolerant to both drought and flooding. The shallow root system renders them vulnerable to drought, and they die if flooded for several weeks (Johnson 1961). Trees planted in poorly drained soils or open areas where water is limited often decline and die (Dirr 1977). Symptoms of prolonged drought are leaf curl and reddening followed by severe dieback of the top (Vimmerstedt 1957).

Plant Associates

Flowering dogwood is found in many hardwood and conifer forest types but is prominent in scarlet oak* and white oak - red oak - hickory associations (Fowells 1965). In the scarlet oak type, associated species are scarlet, black, southern red, chestnut, white, and post oaks; hickories; blackgum; sweetgum; black locust; and pitch, shortleaf, and Virginia pines. Besides oaks, dogwood associates in the white oak - red oak - hickory type are yellow poplar; white ash; pignut, shagbark, and mockernut hickories; red maple; American beech; and blackgum (Fowells 1965). In moist eastern forests, dogwood may be found with the following species: magnolias, sourwood, maples, redbud, American hornbeam, eastern hophornbeam, and American holly (Braun 1950).

WILDLIFE VALUE

Dogwood is considered an important food plant for numerous game and nongame wildlife species (Table 1). Many species of birds consume its fruit, and some eat the buds and flowers ([illegible] and [illegible] 19[illegible]). Dogwood fruit is a preferred food of the wild turkey and is readily eaten by ruffed grouse and northern bobwhite (Halls [illegible]). It is also considered a preferred food item of the northern mockingbird, brown thrasher, American robin, cedar waxwing, [illegible] cardinal, eastern bluebird, yellow-rumped warbler, and species of [illegible], woodpeckers, and [illegible] (Martin et al. [illegible], De [illegible] and [illegible] [illegible]). [illegible] several other [illegible]

* [illegible]

Table 1. Wildlife species reported to use flowering dogwood as a food source (after Martin et al. 1951, DeGraaf and Witman 1979)

Waterfowl (fruit)

Wood duck (*Aix sponsa*)*

Upland Game Birds (fruit, buds)

Wild turkey (*Meleagris gallopavo*)*
Ruffed grouse (*Bonasa umbellus*)
Northern bobwhite (*Colinus virginianus*)
Ring-necked pheasant (*Phasianus colchicus*)

Songbirds (fruit)

Northern flicker (*Colaptes auratus*)*
Pileated woodpecker (*Dryocopus pileatus*)*
Red-bellied woodpecker (*Melanerpes carolinus*)*
Red-headed woodpecker (*M. erythrocephalus*)*
Yellow-bellied sapsucker (*Sphyrapicus varius*)*
Downy woodpecker (*Dendrocopos pubescens*)
Hairy woodpecker (*D. villosus*)*
Eastern kingbird (*Tyrannus tyrannus*)
Great crested flycatcher (*Myiarchus crinitus*)
Tree swallow (*Tachycineta bicolor*)
American crow (*Corvus brachyrhynchos*)
Northern mockingbird (*Mimus polyglottos*)*
Gray catbird (*Dumetella carolinensis*)
Brown thrasher (*Toxostoma rufum*)*
American robin (*Turdus migratorius*)*
Wood thrush (*Hylocichla mustelina*)*
Hermit thrush (*Catharus guttatus*)*
Gray-cheeked thrush (*C. minimus*)*
Swainson's thrush (*C. ustulatus*)*
Eastern bluebird (*Sialia sialis*)*
Cedar waxwing (*Bombycilla cedrorum*)*
European starling (*Sturnus vulgaris*)*
Warbling vireo (*Vireo gilvus*)
Red-eyed vireo (*V. olivaceus*)
Yellow-rumped warbler (*Dendroica coronata*)*
Pine warbler (*D. pinus*)
House sparrow (*Passer domesticus*)
Common grackle (*Quiscalus quiscula*)
Scarlet tanager (*Piranga olivacea*)
Summer tanager (*P. rubra*)*
Northern cardinal (*Cardinalis cardinalis*)*
Rose-breasted grosbeak (*Pheucticus ludovicianus*)
Evening grosbeak (*Hesperiphona vespertina*)*

(Continued)

* Indicates heavy use.

Table 1 (Concluded)

Songbirds (fruit) (Cont.)
Pine grosbeak (*Pinicola enucleator*)
Purple finch (*Carpodacus purpureus*)
White-throated sparrow (*Zonotrichia albicollis*)
Song sparrow (*Melospiza melodia*)
Mammals (fruit, wood, twigs, foliage)
White-tailed deer (*Odocoileus virginianus*)*
Black bear (*Ursus americanus*)
Raccoon (*Procyon lotor*)
Striped skunk (*Mephitis mephitis*)
Gray fox (*Urocyon cinereoargenteus*)
Eastern cottontail (*Sylvilagus floridanus*)
Beaver (*Castor canadensis*)
Gray squirrel (*Sciurus carolinensis*)
Fox squirrel (*S. niger*)
Eastern chipmunk (*Tamias striatus*)
Woodrats (*Neotoma* spp.)
White-footed mouse (*Peromyscus leucopus*)

utilize dogwood foliage, twigs, and bark as well as the fruit (Van Dersal 1938, Chapman 1947, Martin et al. 1951, Vines 1960, Lesser and Wistendahl 1974).

Game Bird Use

Ruffed grouse. Ruffed grouse eat the buds and flowers of dogwood in spring (Halls 1977) and utilize the drupes heavily in fall (Korschgen 1966, Stafford and Dimmick 1979). In a 4-year study in central Missouri, dogwood occurred in approximately 10% of 7000 fecal samples and was present in all months except June (Korschgen 1966). Dogwood fruit was found in 18% to 26% of the samples collected from September through November and was ranked as one of the principal fall foods. The fruit was also important in the diet of grouse in the Cumberland Plateau of southern Tennessee, where it contributed 11% of crop contents taken from fall and winter birds (Stafford and Dimmick 1979).

Wild turkey. The eastern wild turkey utilizes dogwood fruit heavily throughout its range (Korschgen 1967). Several studies have shown that the fruit constitutes a significant portion of wild turkey diet in the southeastern states. It is an important food source along woodland edges in the Southeast (Arner and Davison 1976); for example, it has been reported as a

common item in the fall and winter diets of turkeys in Alabama (Davis 1976) and northeast Mississippi (Billingsley and Arner 1970). Dogwood drupes were found to be prominent in the diet of wild turkeys in the Missouri Ozarks from September to February (Dalke et al. 1942). They were contained in 10% of 115 crops of wild turkeys collected over a 3-year period during the fall and early winter on the George Washington National Forest, Virginia, and dogwood was fourth in importance among all foods analyzed in the study (Martin et al. 1939).

White-tailed Deer Use

Dogwood is an important food plant for white-tailed deer, contributing browse in spring and summer and fruit in fall and early winter (Madson 1961, Mitchell 1980). It has been found in deer diets of the Northeast (Bramble and Goddard 1953, Watts 1964, Stiteler and Shaw 1966, Welch and Flyger 1977) but is especially important to deer in southern forests because of its widespread occurrence and high fruit production (Johnson 1961, Halls 1977). In east Texas, maximum dry-weight yields of fruit were 1.7 lb for 11-year-old trees growing in the open and 0.2 lb for plants growing beneath pine trees (Halls 1977). Fruit remains were found in 16% of deer rumens and also in fecal pellets collected in Trinity County, Texas, during November and December (Lay 1965).

Studies from browse surveys and rumen content analyses indicated that flowering dogwood is heavily utilized by white-tailed deer in pine-hardwood forests of the southern United States (Pearson 1943, Hosley 1956, Halls 1974, Halls and Boyd 1982). Rumen and fecal analyses of deer in the longleaf pine forests of southeast Mississippi showed that dogwood browse constituted from 13% to 20% of deer diets in April and May and from 1% to 10% during the rest of the year (Mitchell 1980). Based on seasonal availability and browse use, dogwood was rated high in spring, summer, and winter in a 9-year study of loblolly pine plantations in east Mississippi (Warren and Hurst 1981) and was ranked as a medium-choice species in a 14-year study conducted in longleaf pine forests of the western gulf region (Goodrum and Reid 1962). Stegeman (1937) assigned dogwood a high palatability rating for deer in the Piedmont Plateau of western North Carolina, and Thill (1983) reported that tame deer in central Louisiana showed high selectivity for the species even when availability was low.

Cattle frequently compete with deer on commonly shared woodland range and may consume up to 50% of the available browse (Halls 1977). Mitchell (1980) found that dogwood browse composed 10% of range cattle diet in May, also a month of heavy use by white-tailed deer in southern pine forests. Cattle in central Louisiana forestlands not only utilized dogwood but also showed high selectivity for this species, especially in spring (Thill 1983).

Nutritional Value

Dogwood provides high levels of several essential nutrients for wildlife. The foliage, twigs, and fruit are high in calcium (Johnson 1961, Halls 1977) and contain amounts well above those needed for adequate skeletal growth by wildlife species (Halls and Oefinger 1969). Fruits collected in Texas contained as much as 1.1% calcium (Lay 1961), and foliage from southern pine-hardwood forests had values ranging from 1.45% to 3.25% (Fowells 1965, Halls and Oefinger 1969, Day and Monk 1977, Blair et al. 1980, Crum and Franzmeier 1980). From 2.0% to 3.5% calcium was found in dogwood leaf litter, a value more than twice that of most its plant associates, including black oak, white oak, shortleaf pine, loblolly pine, and sweetgum (Coile 1940, Oosting 1942). Dogwood leaves decompose rapidly, thus making their mineral constituents readily available in the soil (Coile 1940).

Studies have shown that dogwood browse generally contains adequate protein to meet wildlife requirements, but crude protein (CP) levels vary with season and location. Browse was low in CP (5% to 7%) in winter samples collected in Texas (Johnson 1961), whereas August samples from the southern Appalachian Mountains showed 10% to 13% CP (Harlow 1985). Fall browse from forests of southern Mississippi contained 29% CP, a high value for hardwood shrub species (Mitchell 1980). However, the samples tested were composites of fall foliage and twigs collected from longleaf pine stands in DeSoto National Forest, which is managed on a 5- to 10-year burn rotation by the USDA Forest Service. Burning practices are apparently compatible with the production of high-quality forage protein, as burning releases readily available nitrogen into the soil.

Dogwood browse is high in manganese and cobalt (Johnson 1961) and accumulates 10 to 30 times more aluminum than maple and oak (Crum and Franzmeier 1980). Both foliage and fruit are high in fat content; 16% crude fat was

found in fruit (Lay 1961), and values ranging from 2% to 13% were found in foliage, depending upon the season of sampling (Blair et al. 1980).

ESTABLISHMENT

Dogwood is frequently planted as an ornamental and is recommended for urban wildlife programs because of its year-round beauty and attractiveness to wildlife, especially birds. Field plantings were not successful in a study conducted in the Northeast (Edminster and May 1951). However, on good soils it may be feasible to use dogwood for improvement of wildlife habitat, especially where fruit-producing hardwoods are scarce (Halls and Oefinger 1969). Guidelines for effective establishment and maintenance of dogwood trees are given in the following sections.

Site Selection

Only sites that provide the proper soil and moisture requirements should be selected for establishing flowering dogwood. It has been suggested for planting along streams, at the edges of farm woodlots, and around farm ponds (Chapman 1947). Dogwood grows well along the margins of southern pine forests (Kramer et al. 1952) and produces abundant fruit in forest openings (Halls and Alcaniz 1972). Therefore, it may be effectively spot-planted around southern forest openings to provide an abundant source of fall food for wild turkeys and woodland songbirds (Fig. 2). Dogwood may also be planted in combination with other shrubs to establish woodland borders or develop corridors for game species such as white-tailed deer and wild turkey.

Site Preparation

Soil amendments. A soil analysis should be done for each potential planting site to determine fertilizer and lime requirements. Results will indicate the extent to which soil amendments are needed for good growth and reproduction. If chemical applications are cost prohibitive for a site, the manager may wish to select another site more suitable for the natural establishment of dogwood.

Mechanical treatment. Sites on which dogwood will be planted should be adequately prepared to promote more productive growth. Seedlings should never be set directly into grass or weed sod (Edminster and May 1951). In wildlife areas the surface can be disked or harrowed to eliminate root competition and improve soil moisture conditions (Coile 1940). If topography will not permit

Figure 2. Dogwood can be planted for wildlife at woodland edges or in forest openings

use of machinery or if single specimens are to be planted, the immediate site is best prepared by a thorough scalping of the sod (Edminster and May 1951). A mattock or shovel can be used to clear a space of at least 1 sq ft around each plant and thus provide a bare spot for each seedling. In urban settings a seedbed may be prepared for ornamental specimens if other species will also be planted. However, the site may be broken with a spade or shovel when spot-planting, and a small garden tiller may be used to mix any needed amendments into the soil (Perry 1985).

Propagules

Dogwood can be grown from seed or nursery stock or can be propagated vegetatively (Fowells 1965). However, the native white flowering dogwood is produced commercially from seed (Badenhop et al. 1985), and the most feasible method for establishing this species on wildlife areas is with seedlings produced in the nursery.

Several methods of vegetative propagation may be used to grow ornamental specimens or to produce cultivars in the nursery, but these are recommended for wildlife plantings only if the manager has had experience with such methods. Types of vegetative propagules that can be used include: softwood cuttings in summer, hardwood cuttings in winter, grafting in winter or spring, layering in spring and summer, and budding in summer (Mahlstede and Haber 1957).

Seeds. Cleaned seeds are preferable for germination in the nursery because the pulp contains a chemical inhibitor that delays germination (Goodwin 1948). The pulp may be extracted by soaking the fruit in water for a few days until the covering can be removed easily (Free 1957). However, large quantities of fruit may be macerated in water or run through a hammer mill, allowing pulp and empty stones to wash away (USDA Forest Service 1948). Seeds should then be dried and stored in an airtight container at 30° to 34° F (Lesser and Wistendahl 1974).

Seeds must be stratified in a moist medium, such as sand or peat moss, for approximately 4 months at 41° F to break dormancy and then be sown 1/4 to 1/2 in. deep in rich nursery soil. Seeds should be sown at a rate of 40 seeds per square foot and mulched with leaves or straw; the mulch needs to be removed at the first signs of germination (USDA Forest Service 1948). Seedlings grown from these seeds can be transplanted at the proper time into the field.

Cuttings. Cuttings are best established with terminal shoots taken from young dogwood trees; these should be approximately 3 in. long and contain 2 to 4 leaves (Pease 1953, Doran 1957). If cuttings are taken immediately after plants flower, the rooted cuttings will have sufficient time to obtain maximum growth and harden before the first winter (Pease 1953). Rooting is generally improved by the application of a root-inducing substance, preferably indole-3-butyric acid (IBA) (Pease 1953, Doran 1957), which is available in commercial preparations. Results are usually better when cuttings are planted in a medium of sand or sandy soil rather than in peat moss (Pease 1953, Doran 1957, Vermeulen 1959).

Grafting. Dogwood can be successfully propagated by grafting during the winter or early spring months. Scions (the shoots or buds used for grafting) may be collected in advance of the grafting work and stored for 3 to 4 weeks in plastic containers with a small amount of sphagnum moss to prevent drying.

Scions should be restricted to wood of the previous growing season, be 8 to 12 in. long and 1/4 in. in diameter, and contain several sets of buds (Coggeshall 1960). Cultivars difficult to start from cuttings, such as the red variety of dogwood, may be propagated by dormant budding, a form of grafting. However, the trunks of budded plants are not as straight as those of rooted cuttings, and budded seedlings may be more susceptible to infestation by dogwood borers because of the trunk wound made during budding (Badenhop et al. 1985).

Layering. Plants produced by layering soft growing shoots are often superior to those raised from hardwood cuttings. Layering is done by starting against the base of the stock plant and working outward, layering the shortest shoots first. A slight twist is all that is needed, but small pegs should be used to keep the layers firm. The layers should be lifted the following spring and set out 1 ft apart (Sheat 1953).

Transplanting

Transplanting nursery-produced seedlings is recommended for establishing dogwood in wildlife areas or urban settings. Results from wild transplants may not be as satisfactory because of the stress sustained from root damage and transplant shock. The procedure is also more time consuming for personnel and requires more expertise than transplanting nursery-grown seedlings.

Propagules. One- to two-year-old seedlings are most feasible for planting on wildlife areas. Either bare-root or containerized stock may be used; bare-root stock is easier to handle, but containerized plants have better survival rates (Landin 1978). Bare-root seedlings are usually less expensive and may be obtained from commercial nurseries in units of 100 to 1000 plants. If it is desired to plant trees 5 to 10 ft tall, transplants should be balled and burlapped (Environmental Laboratory 1986).

Only seedlings that show potential for successful establishment should be selected. Healthy twigs are pliable and contain new growth at the tips. Larger transplants should be checked for frost cracks, mechanical injury, wet spots, and decay at the junction of stem and roots. Indications of dead plants are loose bark, brittle twigs, and hard buds that are easily removed (Environmental Laboratory 1986).

Timing. The best time to plant bare-root seedlings and larger dogwood specimens is late fall after plants have become dormant and when rainfall is

adequate. Containerized stock can be planted any time of year that the soil is not frozen and moisture is sufficient; however, fall planting generally yields good results.

Transplants on sandy soils and south-facing slopes may undergo stress, as these sites tend to be hot and dry and induce physiological drought in new plants (Environmental Laboratory 1986). Therefore, the time for transplanting on these sites is just before or after the most likely occurrence of precipitation. Transplanting should not be done if weather conditions indicate more than 3 or 4 days with no rain.

Planting procedures. The procedures for transplanting depend chiefly upon local soil factors and the type of propagule used. The method recommended is center-hole planting, in which a hole is dug in the scalped earth and the seedling is placed in the middle of the hole with the root collar at ground level (Edminster and May 1951). Thus, seedlings should be at the same depth or approximately 1/2 in. deeper than they grew in the nursery (Environmental Laboratory 1986).

Soil conditions will influence the size of the planting hole. In sandy and loamy soils the transplant hole should be 2 spade widths broader and deeper than the root spread. The bottom of the hole should be loosened only 1 spade length deeper in clayey or compacted soils, but care must be taken to prevent settling of the plant and subsequent drowning. Injured roots should be pruned so that the cut roots point downward, and excavated soil should be retained to backfill the hole around the seedling (Environmental Laboratory 1986).

With bare-root seedlings, the transplant hole must be large enough to avoid bending the roots during placement. Roots should be spread evenly so the backfill can be worked around them to obtain good root-soil contact. Water that is run slowly over the root area will eliminate air pockets, settle the soil, and bring it into firm contact with the roots (Harris 1982).

Circling or matted roots should be clipped from a containerized plant following its removal from the container. After the seedling is set into the hole, the backfill soil should be added and firmed gradually to ensure good root contact. If the original soil line is buried after watering, the trunk can be grasped near the soil and lifted slightly above the proper level so that the plant can settle back to the desired depth (Harris 1982).

The planting hole for balled and burlapped transplants should be about twice the width and depth of the root mass (Perry 1985). The wrapped rootball should be set carefully into the partially filled hole and all ties removed. Prior to soil replacement, the burlap should be folded away from the trunk and the edges buried well below the soil surface to prevent wick action from drying out the rootball (Harris 1982). Tamping firmly settles the soil and prevents air pockets (Perry 1985).

Transplants should be watered to prevent desiccation that may result from transplant shock. Bare-root seedlings should be kept moist, and containerized stock should be watered frequently until planted; both transplant types should be watered during planting after the hole is two-thirds filled with soil (Landin 1978). A small levee built around the edge of the backfill to form a shallow basin allows water to soak into the soil with a minimum of runoff (Harris 1982). The ring of soil forming the levee should be 6 in. high, and the basin should be about 3 ft in diameter (Perry 1985).

Fertilization. The application of nitrogen usually produces more rapid growth in young trees but also encourages weed competition. If amendments are required for soils of low fertility, a complete fertilizer (one containing *nitrogen, phosphorus, and potassium*) is recommended. The rate of application can be adjusted according to the percentage of nitrogen in the fertilizer. One way to determine usage is to measure the stem diameter and apply 0.1 to 0.2 lb of nitrogen per inch of stem diameter; that would be 1 to 2 lb of a 10% nitrogen fertilizer such as 10-8-7. The total amount of fertilizer should be applied at 2 intervals, one half in the spring and one half in summer. It should be placed at least 6 in. away from the trunk to avoid injuring the plant, and the soil should be watered immediately to dissolve and percolate the fertilizer into the soil (Harris 1982).

Mulching. An organic mulch may be used after planting to reduce moisture loss, soil erosion, and weed competition and to moderate soil temperatures. Mulch should be applied 3 to 5 in. deep and at least 6 in. from the trunk (Harris 1982). Effective organic mulches include straw, leaves, sawdust, wood shavings, bark, rice hulls, and peat moss.

MAINTENANCE

Dogwood planted on good sites should require little maintenance beyond the first few years. Trees planted in the spring will require watering

throughout the summer if rainfall is low. Plants should be thoroughly watered each week that it does not rain; the most crucial months will be May through September, especially in the Southeast (Perry 1985).

Dogwood planted on suitable sites should require no fertilizer after 2 to 3 years. Nitrogen was shown to produce marked radial growth of dogwood trees on soils of low to moderate fertility only during the first growing season after fertilization (Curlin 1962). Maturing trees need fertilizer only as indicated by leaf color. If fertilizer is required, it should be applied to an area around the tree with a radius slightly greater than that of the canopy (Harris 1982). If growth is excessive on young trees, less fertilizer or none at all will be needed.

The trunks of newly planted trees are susceptible to sun scald, a winter injury caused by freezing sap in the young trunks. Sun scald can be prevented by wrapping the trunk with a protective tree wrap, which is usually available from local nurseries and garden centers. The trunk should be wrapped from the bottom to the first major branches and tied with a soft cotton string that will not cut into the tree (Perry 1985). This procedure will probably be feasible only for specimen trees in urban areas.

Balled and burlapped trees may need to be staked and tied to prevent the wind from moving the rootball and subsequently damaging the roots. A single stake can be used for trees less than 6 ft tall, but larger plants will require at least 2 stakes. Commercially prepared anchors are available (Perry 1985).

CAUTIONS AND LIMITATIONS

Propagules

Seeds from southern sources should not be planted in the North and Northeast, as they are not adequately hardy under climatic conditions in these areas. Within 3 to 5 years, trees grown from southern seeds will show limited flower production, caused principally by lack of flower bud hardiness. Therefore, propagules used in the northern states should originate from trees indigenous to those areas to ensure not only survival but also maximum flower and fruit production (Dirr 1977).

Disease and Insect Damage

Plants should be checked at regular intervals to detect insect damage and plant disease symptoms. Dogwood is susceptible to several fungal diseases, chiefly spot anthracnose, leaf spots, basal trunk canker, and nectria canker. Anthracnose attacks the flowers, leaves, fruits, and young shoots, producing spot-like lesions that destroy these tissues. The fungus overwinters in infected plant tissues and reinfects the new growth each spring; therefore, control of this disease requires application of labeled fungicides prior to blooming. The fungicides used for anthracnose will usually control other leaf spot fungi (Blasingame and Cochran 1979). It should be noted that fungicides are probably feasible only in urban settings.

Cankers are caused by fungi that usually enter the plant through wounds on the trunk. Indications of canker include large swollen areas, bleeding sap, and splitting bark. If detected early, small cankers can be controlled by cutting the tissue back to healthy wood and applying a wound dressing (Blasingame and Cochran 1979).

Crown gall is caused by soilborne bacteria that enter the plant through wounds and attack the lower trunk and upper root zone. The disease produces abnormal growth, and large galls appear on the root crown (upper root system). When buying larger plants, those with knots on the trunk should be avoided. Dogwood should not be replanted for 3 to 5 years in an area where a plant has been killed by crown gall (Blasingame and Cochran 1979).

Major insect pests of dogwood include the dogwood borer, dogwood twig borer, flat-headed borer, and a reddish brown fly that causes club-gall. The most harmful of these is the dogwood borer, which prefers wounds on the trunk for egg deposition (Blasingame and Cochran 1979). The larvae feed on the phloem layer of the plant, and several can kill a tree if they girdle the trunk. Two tree characteristics, severity of trunk wounding and degree of exposure to sun, were found to be most important in determining the probability of borer attack (Potter and Timmons 1981). Weakened dogwood trees are more susceptible to insect attack than are healthy trees. Native trees in their natural habitat are seldom attacked by borers, and transplanted trees are much less likely to be attacked if they have not sustained damage by sun, lawn machinery, construction equipment, or strong winds (Blasingame and Cochran 1979).

The best control of disease and insect damage is to avoid injury to young trees. Wounds caused by mechanical damage are major points of entry for insects and pathogenic organisms; therefore, care must be taken to avoid injury while working around dogwood plants. If injury does occur, a wound dressing or pruning paint should be applied immediately to seal the damaged area. A mulch around the base of trees in urban settings will prevent grass from growing and will eliminate the necessity of mowing near the trunks (Blasingame and Cochran 1979).

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APPENDIX A: COMMON AND SCIENTIFIC NAMES OF PLANTS MENTIONED IN TEXT*

Common Name	Scientific Name
American beech	*Fagus grandifolia*
American hornbeam	*Carpinus caroliniana*
American holly	*Ilex opaca*
Blackgum	*Nyssa sylvatica*
Black locust	*Robinia pseudoacacia*
Eastern hophornbeam	*Ostrya virginiana*
Hickory	*Carya* spp.
Mockernut hickory	*C. tomentosa*
Pignut hickory	*C. glabra*
Shagbark hickory	*C. ovata*
Magnolia	*Magnolia* spp.
Maple	*Acer* spp.
Red Maple	*A. rubrum*
Oak	*Quercus* spp.
Black oak	*Q. velutina*
Chestnut oak	*Q. prinus*
Post oak	*Q. stellata*
Red oak	*Q. rubra*
Scarlet oak	*Q. coccinea*
Southern red oak	*Q. falcata*
White oak	*Q. alba*
Pine	*Pinus* spp.
Loblolly pine	*P. taeda*
Longleaf pine	*P. palustris*
Pitch pine	*P. rigida*
Shortleaf pine	*P. echinata*
Virginia pine	*P. virginiana*
Redbud	*Cercis canadensis*
Sourwood	*Oxydendrum arboreum*
Sweetgum	*Liquidambar styraciflua*
White ash	*Fraxinus americana*
Yellow poplar	*Liriodendron tulipifera*

* Scientific names follow Radford et al. (1968).